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EFFECTS OF SLASH BURNING ON CONIFER REGENERATION IN SOUTHEAST ALASKA

by

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Clearcutting and high-lead logging of old-growth western hemlock[1] and Sitka spruce results in a variety of ground conditions for seedling establishment. Slash accumulations, brush, bare mineral soil, litter and duff, undisturbed moss, rotten wood, and combinations of these create a mosaic of favorable and unfavorable seedbeds. In southeast Alaska fire hazard is usually low and logging slash is left unburned. Cutover land usually restocks naturally soon after logging, but seedling distribution is far from uniform, and control over species composition is lacking.

This report describes a test made to determine whether slash burning would improve seedling distribution by providing a more uniform seedbed, and favor Sitka spruce, a highly desirable species.

The test was made on a cutover area at Kina Cove, Prince of Wales Island, about 35 miles west of Ketchikan. The ground was flat to gently sloping, with a northwest aspect. Over-mature western hemlock and Sitka spruce timber, harvested from the area in 1955-6, averaged 41,000 b.f. (Scribner) per acre. Only scattered saplings, poles, and snags remained after logging. Before burning, moderate slash over moss was the most common ground cover with slash concentrations scattered over the area. The dominant vegetation was huckleberry and blueberry brush over moss. Dense salmonberry patches were common on flat ground along the lower edges of both burned and unburned areas.

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[1] Scientific names of plants mentioned are listed on page 6.

METHODS

Following 6 rainless days in July 1957, logging slash on 30 acres of a large cutover area was burned. The slash, 1-1/2 to 2 years old, produced a uniform, light burn. Almost no slash over one-fourth inch in diameter was consumed except where fuel was concentrated. Brush growing under slash was burned down to short stubs, and little of the surface organic layer was scorched to a depth greater than one-fourth inch.

Fifteen days after burning, fifty 1-milacre circular plots were systematically spaced in the burn and 50 in an adjacent unburned area of similar site conditions. Advanced seedlings already established were removed to avoid confusion with those germinating later, and the equivalent of one-fourth pound per acre of both western hemlock and Sitka spruce seed was hand-sown on each plot to insure immediate reseeding. Three months later, on October 1, both burned and unburned areas were aerial seeded with the same seed mixture as part of a larger seeding operation. All seed was treated with endrin and coated with aluminum powder for protection from seed-eating mammals and birds. Surrounding uncut timber also contributed seed. Natural seedfall was not measured but was assumed to be similar in quantity and species composition on both burned and unburned areas.

Seedlings were counted and vegetative cover estimated during late summers of the first three years after burning, and again in the spring of 1965, seven growing seasons after burning. In 1965 a concentric 4-milacre circular plot was established at each 1-milacre plot location in order to include an area from which advanced seedlings had not been removed. The percentage of 4-milacre plots stocked with at least one established seedling was determined, and the size and species of the largest seedling on each 4-milacre plot was recorded.

RESULTS

Seedlings established in 1958 (table 1) were from natural seedfall and from sown seed. Because of a light seed crop in 1957-8 it is probable that most seedlings grew from sown seed. Few seedlings became established during 1959, reflecting the lack of sown seed and light seed crop in 1958-9. In 1960 many seedlings became established from a heavy seed crop in 1959-60.

Table 1.--Effects of burning on seedling establishment and survival

Treatment and species	Initial seedling establishment				Seedling survival[1]	
	1958	1959	1960	Total	1965	
	Number per acre				Number per acre	Percent
Burned						
Spruce	880	100	2,780	3,760	740	20
Hemlock	1,400	40	7,920	9,360	320	3
Unburned						
Spruce	1,360	0	960	2,320	500	22
Hemlock	3,880	0	21,420	25,300	1,100	4

[1] Includes only seedlings at least 6 inches tall.

More hemlock than spruce became established on both burned and unburned plots during 1958 and 1960, reflecting the preponderance of hemlock in the surrounding timber seed-source. In 1959 more spruce than hemlock seedlings became established on the burn, and no seedlings became established on the unburned plots. Differences in seedling establishment proved to be statistically significant at the 5 percent level of probability[2] only in 1960. The total number of hemlock seedlings established over the 3-year period, 1958-60, was significantly greater than the number of spruce on both burned and unburned plots. The ratio of spruce to hemlock seedlings on the burned plots was 1: 4, and on the unburned, 1: 11.

Seedling survival was estimated by dividing the total number of seedlings established in 1958-60 on 1-milacre plots into the number of seedlings present in 1965. Seedlings established after 1960 were virtually eliminated by counting only seedlings 6 inches tall.

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[2] Differences in seedling numbers were tested by median and chi-square tests in which the frequency of plots containing various numbers of seedlings were compared.

By the spring of 1965, seven growing seasons after burning, seedling numbers were greatly reduced (table 1). Mortality appeared to be independent of burning, but spruce mortality was less than one-fifth that of hemlock. Lower spruce mortality, combined with the higher ratio of spruce to hemlock on the burned plots, resulted in more than twice as many spruce as hemlock seedlings surviving on the burned plots.

By 1965, stocking percent was significantly higher on the burned area with 92 percent of 4-milacre plots containing at least one seedling over 6 inches tall, compared with 78 percent on the unburned area.

On the burn, a spruce was the largest seedling present on 56 percent of 4-milacre plots, a hemlock on 36 percent. This situation was reversed on the unburned area where a hemlock was dominant on 46 percent of plots and a spruce on 32 percent.

Height of hemlock seedlings averaged 8.2 feet on the unburned area and 3.7 feet on the burn, a significant difference. Dominant spruce averaged 4.6 feet on the unburned area and 3.2 feet on the burn, not significantly different. Dominant seedlings in the unburned area were primarily those already established in the understory of the harvested stand that had escaped logging. Most such advanced seedlings on the burned area were killed by fire.

Burning temporarily reduced competition from brush and herbaceous plants. By the end of the first growing season brush covered 7 percent of the burned area and 16 percent of the unburned area. Regrowth on the burn was more rapid during the next three growing seasons and nearly equal on both areas thereafter. By the seventh growing season brush cover was nearly equal on the burned and unburned areas, 49 and 52 percent, respectively, with different species dominant (fig. 1).

The year after burning, herbs and moss covered 7 percent of the burned area and 28 percent of the unburned. Regrowth was rapid on the burn, slower on the unburned area, reaching a peak coverage of 40 percent and 34 percent, respectively, by the third growing season. Thereafter, herbaceous cover declined, as brush and tree cover replaced it. Burned and unburned areas differed little in the extent of unvegetated areas. Decay of slash and logging debris appeared to have been accelerated by burning.

DISCUSSION AND CONCLUSIONS

Fewer seedlings became established on the burn, but stocking percent was higher, showing that the seedlings present were better distributed. The percentage of spruce was higher on the burn. The reason for the improved response of spruce on burned plots is not known, although it appeared to be related to improved conditions for initial spruce seedling establishment, rather than improved survival under burned conditions.

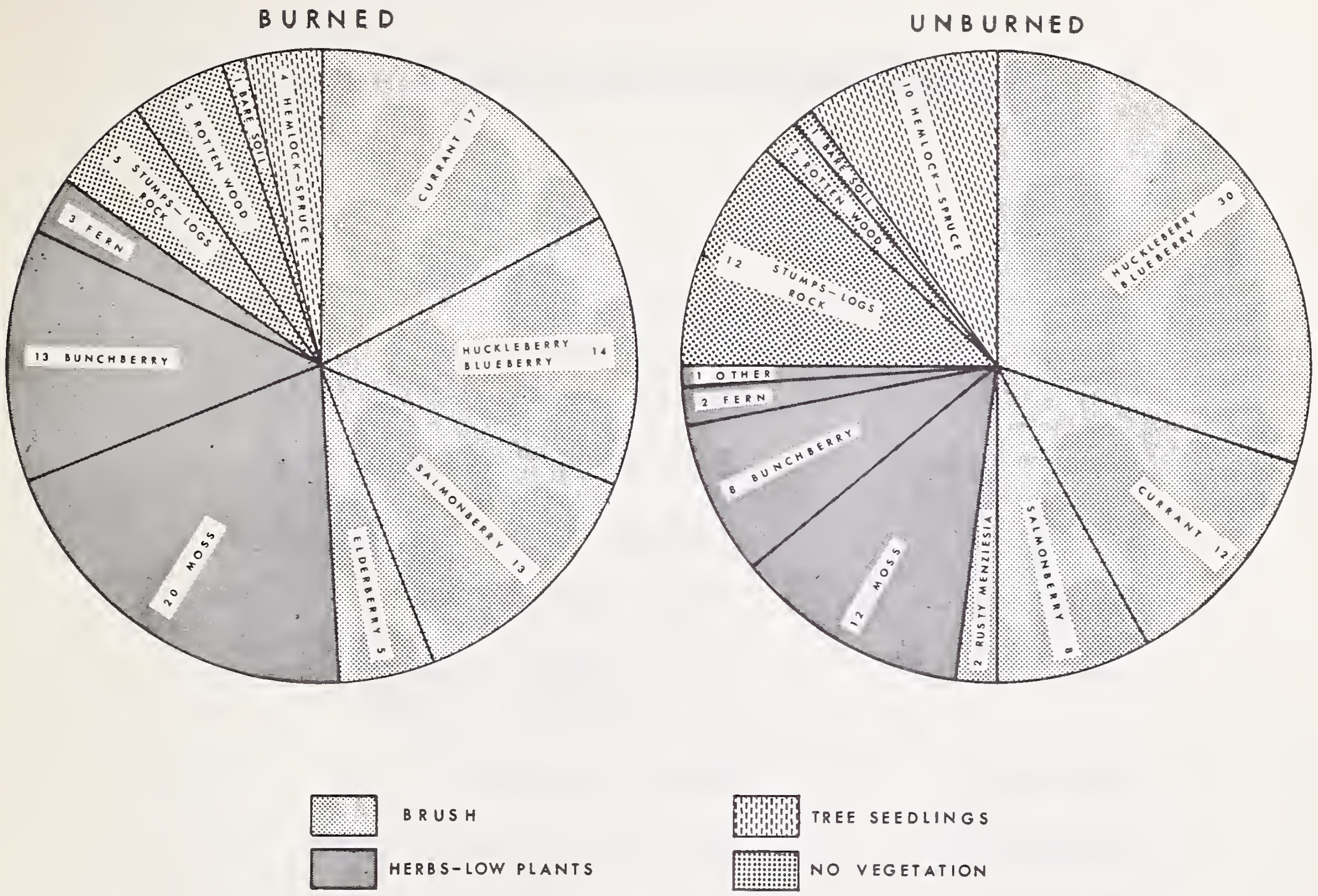

Figure 1.--Ground cover on burned and unburned cutover land seven growing seasons after a light slash burn, Kina Cove, Alaska.

The test was not designed to evaluate differences in seedling growth rate due to burning. However, the vigor, color, and recent growth of seedlings on burned and unburned areas did not appear to differ greatly. Burning destroyed advanced hemlock seedlings which normally dominate the early stand. This resulted in early growth losses in the stand as a whole, but strengthened the competitive position of spruce.

Slash burning appears to offer possibilities for increasing the percentage of spruce in young second-growth stands. However, the long-term effect of species composition on stand development, and the effects of light burning on site productivity and soil stability are not known. Until more is known about these factors, slash burning following clearcutting is not recommended. In this test, adequate regeneration was obtained without burning.

COMMON AND SCIENTIFIC NAMES OF PLANTS

TREES

Sitka spruce	*Picea sitchensis* (Bong.) Carr.
western hemlock	*Tsuga heterophylla* (Raf.) Sarg.

BRUSH

bunchberry	*Cornus canadensis* L.
currant	*Ribes bracteosum* Dougl. *R. laxiflorum* Pursh.
elderberry	*Sambucus racemosa* L.
huckleberry	*Vaccinium parvifolium* Smith
blueberry	*V. alaskensis* Howell *V. membranaceum* Dougl. *V. ovalifolium* Smith
rusty menziesia	*Menziesia ferruginea* Smith
salmonberry	*Rubus spectabilis* Pursh.

HERBS - LOW PLANTS

fern	*Athyrium felix-femina* (L.) Roth *Pteridium aqualinum pubescens* Underw.
moss	*Musci* class

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